ACRIDIDAE OF RANGELANDS IN EASTERN KANSAS

HERBET KNUTSON

Department of Entomology (Contribution Nº 1193–A)
Kansas Agricultural Experiment Station,
Kansas State University, Manhattan, Kansas 66506 U.S.A.

Grasshoppers are among thee most destructive insects in Kansas. Severe outbreaks were caused in the state by the so-called Rocky Mountain grasshopper, *Melanoplus spretus,* now extinct, which periodically destroyed much of the Great Plains crops. *M. spretus* was a truly migratory species. Its severest damage in Kansas occurred intermittently during the period 1846 through 1877, the worst in 1874.

Other major outbreaks, involving other species, were in 1913 and in 1936 and 1937 near the end of several severe drought years with high temperatures. A moderate outbreak in southeastern Kansas in 1953 moved locally westward,taking several years to reach by the west state line. Another series of outbreaks may be forthcoming; grasshoppers appeared locally in 1976 in southeastern Kansas and certain other areas, after 2 or 3 years of drought.

Smith (1954), summarizing grasshoppers in Kansas, 1854-1954, arrived at certain conclusions, including: grasshoppers increased in dry years as shown by the population the next year; outbreaks followed 2 successive years of sub-normal rainfall; populations were generally low in years when rainfall was above normal in a given summer and the next year; no clear correlation was discernible between total precipitation during six summer months and numbers of grasshoppers; cool, damp periods in June and July resulted in an epidemic of "diseases" that appreciably reduced grasshoppers; no significant correlation between mean annual temperatures and populations was discernible; in general, populations peaked at intervals of 4 to 6 years and were lowest at intervals of 6 to 8 years; while the numbers each year must be dependent in some way on the kind, amount, and quality of natural food available, modified directly by the weather as from dashing rains and by extreme temperature, and indirectly as weather affects plants, parasites, predators, and diseases, the data available on food do not permit a correlation to be made with populations; predators, parasites. Diseases affected numbers both in the current and succeeding years of major attacks; results of heavy killing by diseases were sometimes discernible in years after cool, damp summers. Dr. Smith's sources of information were based more on cropland than rangeland grasshoppers, and little information was available for most of the 100 years.

REV. SOC. ENT. ARGENTINA, Tomo 36 (1-4): 41-44.

Since then, the chlorinated insecticides that were so effective now are either banned or in the process of being banned, as are some other insecticides.

From 1960 through 1970, a Cooperative (North Central States) Regional Project, "Factors Influencing the Distribution and Abundance of Grasshoppers", was funded by the U. S. Department of Agriculture and certain State Agricultural Experiment Stations. No serious, widespread outbreaks occurred during those 10 years. The project was directed toward more fundamental studies rather than insecticide control under emergency conditions. Primary participants were Kansas, Nebraska (the next State north) and North Dakota, which borders Canada. Among the findings were: populations among species fluctuated independently, with highest positive correlations among species not concurrently competing for the same habitat or food, despite sufficient space and food for all; grasshopper species in the same habitat and with similar food requirements had different population cycles, indicating they also were influenced by other environmental factors; good range management practices tended to stabilize grasshopper populations but did not necessarily eliminate them as competition for range forage. A detailed analysis of the feeding preferences, selectivity, and forage damage potential for North Dakota, Nebraska, and Kansas has been published (Mulkern *et al* .1969).

The present report covers in part grasshopper studies of grassland and rangeland in the bluestem grass strip, often called the "Flint Hills", which constitutes a north-south strip of 4 million acres (1.6 million hectares). Immediately east is the bluegrass strip, and west is the bluestem-short grass strip. Comparatively little is known about the grasshoppers of rangeland because rangeland is a relatively low income crop and damage is less apparent than in row crops.

Rainfall decreases from about 40 inches per annum in southeastern Kansas to 18 inches in the western portion. Until recently, it could be stated that short grass prairie replaces forest and tall grass prairie, from east to west. But thousands of hectares have gone into irrigated corn (maize) in western and central Kansas. To date, no substantial populations of grasshoppers have developed in the newly irrigated areas, but, based on studies in eastern Kansas, mixed forb-grass feeders such as *Melanoplus bivittatus* and *M. sanguinipes* can move from grasslands to cultivated crops and *vice versa.* Others like *M. differentialis* are seldom, if ever, found in pure grassland or rangeland but will surely move in from weedy field margins.

Our studies have been conducted primarily near Manhattan, Kansas, where precipitation averages 33 inches a year.

Melanoplus confusus Scudder and *Melanoplus bivittatus* (Say) matured on western ragweed, *Ambrosia psilostachya* D. C. but neither attained more than the 4th instar on Louisiana sagewort, *Artemesia ludoviciana* (Nutt, T. & G.). *Melanoplus keeleri luridus* Dodge matured on *A. psilostachya* and western yarrow, *Achillea millefolium* L., but it attained only the 4th instar on Louisiana sagewort. Development to adult was 12 days longer among early-season-collected first instars than among those collected 30 days later; both temperatures and current stage of development of the host plant were influencing factors. *Hypochlora alba* matured on Louisiana sagwort but attained only the 3rd instar on western ragweed. Development times in all but the 4th instar of the 3 species surviving on western ragweed differed significantly.

Other studies (Campbell *et al* 1974, Knutson and Campbell 1976) generally indicate that: (1) the more available a favorite hostplant is, the more readily it is ingested, and the larger the grasshopper population; (2) grasshoppers inhabit the Loamy Upland and Clay

Upland Range Sites about equally, and considerably more than the Limestone Breaks Range Site; (3) populations decrease when burning is delayed during the early part of the growing season; and (4) populations increase as cattle-grazing increases.

Our current field insecticide evaluations involve Latin squaredesigned mini-plots, each replicated 4 times, in rangeland. A 12-inch high metal shield surrounds each plot to minimize nymphs jumping from one plot to another. We are evaluating both legally approved and experimental insecticides, including pyrethroids. Plots contain about 7 to 14 principal plant species, primarily grasses; and 12 to 16 additional species of forbs. Basal ground cover varies from 4 to 15 o/o; plants average 4 inches high. There are 12 to 14 grasshopper species in the plots. Mortality is recorded daily for several days. Additionally, glass boxes, 6" x 6" x 9", are sprayed on the inner surface while containing 10 grasshopper specimens. The box is then covered with cheesecloth. Behavior response, morbidity, and mortality among species of nymphs and insecticidal treatments are recorded for several days (I. Javadi, leader).

The so-called "Pest Management" approach is widely acclaimed, and practiced with some crops in the United States. As is well known, it should involve using a certain control or suppression measure (s) at the right time and intensity and only when needed, as determined by the economic threshold (when the insect population is sufficiently damaging that control measures should be initiated). Among the factors to which we have devoted special attention are: (1) species that are beneficial or at least neutral because they feed on grasses or forbs of little or no value to livestock so no control is needed; (2) recognizing young instars early so they may be suppressed while still in a small area where egg pods were laid, so relatively little insecticide is needed; (3) determining seasonal history from hatching until the females lay eggs; (4) relationship between rangeland management procedures and grasshopper populations; and (5) evaluating pyrethroids and other approved and experimental insecticides to replace the now-prohibited insecticides, taking into consideration relative effects among species and instars within species.

We plan to continue studies of antibiosis. Both behavioral and biochemical approaches are emphasized.

We will continue to expand illustrated keys to the grasshoppers of Kansas, with more details on variation within species, separating close-appearing species and sexes, and recording micro-habitats and detailed seasonal histories.

We shall attempt improved evaluation of the extent of loss, particularly when grass and other plants are tall and close together. Although we know whether or not a certain plant species is ingested, we do not know, for example, how much is ingested, or whether the leaf is nibbled at the tip or at the base, which could sever the entire leaf. In our study area, grasshoppers generally hatch after the plants are well along in spring growth, so moderate feeding as the plants mature may be beneficial by pruning. Furthermore, some species are reported to change to more succulent hostplants as initial plant(s) ingested become drier, but we have not observed such switch-overs to any extent in our studies.

From a practical standpoint, during a year of good growth grasshopper feeding may cause little or no noticeable loss, while during droughts their feeding damage may be visibly extensive with no increase in grasshopper population. Many other factors may be involved: they may feed closer to the ground than livestock do, thus destroying the growing tips; soil erosion may follow denuded areas; grasshoppers may be irregularly distributed in a field, even when favorite hostplants are present.

Hence, mere counts per square yard are not valid, although they probably now are the best practical method in our state where the grasshopper species-hostplant relationships are known. Vegetation plays an important role beyond providing food: its height and desity, for example, both influence the size and incidence of open spaces. Unpredictable weather is highly important.

We are attempting to improve methods of measuring grasshopper density. High vegetation limits the value of sweeping because practically no nymphs are taken. Bottomless cages have been placed when grasshoppers are inactive so they may be counted in daytime. Quick traps that suddenly release a trap onto an area of known size are used, as are vacuum hoses to suck up all insects (and some dirt and small stones). A detailed knowledge of grasshopper habits is important in population surveys. The survey must take into account which species fly, which remain motionless or "frozen", which crawl to opposite sides of stems, and which burrow into debris or cracks in the ground. Such behavioral studies are being conducted at the Konza Prairie Site.

When based on 16 years' records of grasshopper populations, such as we have amassed, a model and preparation of a Dest management approach may be feasible for grasshopper species. But we will still lack, among other things, data on predators, parasites, and disease. Knowledge of development of grasses resistant to grasshopper attack, still in its infancy, would help such a pest management program.

LITERATURE CITED

CAMPBELL, JOHN B., ARNETT, W. HAROLD, LAMBLEY, J.D., JANTZ, ORLO K. & KNUTSON, HERBERT, 1974. Grasshoppers (Acrididae) of the Flint Hills Native Tallgrass Prairie in Kansas.. *Kansas agric. Exp. Sta. Research Paper* 19, Jan., 147 p.

KNUTSON, HERBERT & CAMPBELL, JOHN B., 1976. Relationship of grasshoppers (Acrididae) to burning, grazing, and range sites of native tallgrass prairie in Kansas. *Proc. Tall Timbers Conf. on Ecological Animal Control by Habitat Management* 6: 107-120. Tallahassee, Florida 32303.

MULKERN, GREGORY B., PRUESS, KENNETH P., KNUTSON, HERBERT, HAGEN, ARTHUR F., CAMPBELL, JOHN B., & LAMBLEY, J. D., 1969. Food habits and preferences of grassland grasshoppers of the North Central Great Plain. *N. C. Regional Pub. Nº 196, Agr. Exp. Sta., N. D. State U.*, Fargo, N. D. 58102. July 31 p.

SMITH, ROGER C., 1954. An analysis of 100 years of grasshopper populations in Kansas (1854-1954). *Tran. Kansas Acad. Sci.* 57(4): 397-433.